

Lesson A7–7

Operating, Calibrating, and Maintaining Grain Harvesting and Handling Systems

Unit A. Mechanical Systems and Technology

Problem Area 7. Agricultural Equipment Systems

Lesson 7. Operating, Calibrating, and Maintaining Grain Harvesting and Handling Systems

New Mexico Content Standard:

Pathway Strand: Power, Structural and Technical Systems

Standard: II: Apply principles of operation and maintenance to mechanical equipment, structures, biological systems, land treatment, power utilization, and technology.

Benchmark: II-A: Perform scheduled services routines to maintain machinery and equipment.

Performance Standard: 7. Maintain vehicle, machinery, and equipment cleanliness and appearance. **9.** Design a preventative maintenance schedule. **11.** Calibrate metering, monitoring, and sensing equipment.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the operating principles of grain harvesting equipment.
2. Explain the calibration of grain harvesting equipment.
3. Identify proper maintenance procedures for grain harvesting equipment.
4. Explain the principles of operating grain drying and handling equipment.
5. Explain the calibration of grain drying and handling equipment.
6. Identify proper maintenance procedures for grain drying and handling equipment.
7. Identify the grain quality standards associated with a given crop.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Combines-Reducing Harvesting Losses (VAS 3049). University of Illinois, Urbana, Illinois: ITCS Instructional Materials.

Combines Selecting and Servicing (VAS 3048). University of Illinois, Urbana, Illinois: ITCS Instructional Materials.

Grain Drying, Handling and Storage Handbook (MWPS-13). Iowa State University, Ames, Iowa, 1988.

Griffin, George A. *Combine Harvesting*. Moline, Illinois: Deere & Company, 1991.

GROWMARK. *FS Grain Drying Guide*. FS Supplies Division, Bloomington, Illinois.

Introduction to Combines (VAS 3047). University of Illinois, Urbana, Illinois: ITCS Instructional Materials.

USDA. *Official United States Standards for Grain*. Federal Grain Inspection Service, USDA, Washington, DC, 1995.

Other Resources. The following resources will be useful to students and teachers:

Farm equipment manufacturers (Case IH, Gleaner, John Deere, New Holland) literature on their line of harvesting equipment.

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
Copies of student lab sheets
Combine parts
Rope to make 10 square feet
Crop seeds (corn, soybeans, etc.)
Moisture tester

Terms. The following terms are presented in this lesson (shown in bold italics):

Allowable storage time
Cleaning
Drying front
Drying zone

Equilibrium moisture content
Feeding
Handling
Lodging
Tailings
Threshing

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Display to the class the parts from different combines (snapping rolls, cutter bar/knives/guards, rasp bars, etc.). Ask students to identify what the parts are used for on a combine.

On the floor, mark-out ten square feet. Tell students this represents an area behind a combine. Place crop seed (corn, soybean, etc.) in the area. Based on the number of seeds used, ask the students how efficient the combine was.

Summary of Content and Teaching Strategies

Objective I: Explain the operating principles of grain harvesting equipment.

Anticipated Problem: What are the operating principles of grain harvesting equipment?

- I. Early combines were known as “harvester-threshers”, machines that were pulled through the fields by teams of horses or mules. Some machines were known only as “threshers” since the grain was first cut and then brought to a thresher for threshing and separating the grain from the straw.
 - A. Today the combine is a complex machine used to harvest and thresh all kinds of grain in a variety of crop and field conditions. The name “combine” developed when the harvesting and threshing operations were “combined” into one complete machine.
 - B. To understand the operation of a combine, look closely at each function of the machine. Once the operation of each of these components is understood, it becomes easier to understand how they relate to each other and to the operation of the entire machine.
 - C. All combines perform six basic functions.
 1. The gathering of the standing crop is referred to as the **cutting** function. Parts of the combine involved include the platform, cutter bar and reel, corn head, snapping unit (gathering chains, snapping rolls, and stripper plates).
 2. Delivering the cut crop material to the threshing unit in a steady, uniform flow is called the **feeding** function. Parts involved include the header or platform auger (table auger), feeder house (feeder conveyor, paddle conveyor or feeder chain).

3. The **threshing** function involves the removal of grain from the head, seedpod or cob, by either a flailing or a rubbing action, or a combination of both. Parts involved include the cylinder or rotor, and concave.
4. Separating the loose grain from the straw is referred to as the **separation** function. The parts involved include the grates, straw walkers, beater or rotary deflector.
5. The **cleaning** function removes the grain from the trash. Parts involved include the cleaning shoe (sieves, chaffer, and fan).
6. Moving the grain throughout the machine is the **handling** function. Parts involved include the clean grain (augers, elevators, and grain tank), tailings (augers and elevators), grain holding (grain tank), and unloading (augers).

Use TM: A7-7A, A7-7B and A7-7C to illustrate various harvesting equipment. An alternative approach is to transfer the information from the transparency masters to a multimedia presentation. Use LS: A7-7A to strengthen student understanding of concepts. Use text material to strengthen student understanding of concepts. Chapter 1 and 2 in *Combine Harvesting and Introduction to Combines* (VAS 3047) are recommended.

Objective 2: Explain the calibration of grain harvesting equipment.

Anticipated Problem: How is grain harvesting equipment calibrated?

- II. Unless the operator knows the source of grain losses, he or she cannot calibrate the machine to reduce the losses. Some losses are due to improper operation and others are caused by improper adjustment.
 - A. Harvesting losses occur in different areas of the harvesting process.
 1. Pre-harvest losses are those which occur in the field before combining. Such losses show up as grain on the ground, the result of wind shatter, lodging, down crop, or weather conditions. The inability of the crop to stand is known as **lodging**.
 2. Header losses occur when the header is operated improperly or when the crop tends to shatter easily. Each type of header: cutting platforms, corn heads, and windrow pickup units has operating characteristics which can cause losses.
 3. Threshing losses are caused by unthreshed grain carried over straw walkers, cracked grain due to overthreshing, or cracked grain due to excessive tailings. Material that is not completely threshed or separated is called **tailings**.
 4. Straw walkers or separator losses are usually caused by feeding too much material over them at slow cylinder speeds and wide concave spacing when the combine is operating at excessive ground speeds. Too much material prevents the grain from falling through the walkers and onto the cleaning shoe.
 5. Cleaning shoe losses may be caused by too much air from the fan, too much material on the chaffer, or improperly adjusted chaffer and sieve.
 6. Leakage losses can occur almost anywhere on the combine. To guard against leakage, inspect the combine to see that all inspection doors, cleaning doors, and drain-

age doors are in the proper position and closed securely. Also check for torn seals, damaged sheet metal, or holes.

- B. The areas of combine (cutting, feeding, threshing, separating, and cleaning) may be responsible for harvesting loss. Determining losses varies with the type of grain harvested.
 - 1. The most difficult problem in harvesting soybeans is getting all the beans into the header. The combine must be operated accurately and gently to allow the most beans possible to enter the machine. After soybeans reach maturity, they tend to shatter and fall on the ground. The loss at the header can account for 90 percent of the total loss.
 - 2. Corn harvesting losses can occur as ear losses and kernel loss. The largest corn loss usually is in ears left in the field.
- C. Precision agriculture equipment, global positioning systems, and yield and moisture monitors are calibrated by following the directions in the owner/operator manual. Vibration, load weights, and temperature are some of the calibrations that need to be made in order for the equipment to be accurate.

Use TM: A7-7D, A7-7E, A7-7F and A7-7G to reinforce the concepts of header loss and how it is calculated. An alternative approach is to transfer the information from the transparency masters to a multimedia presentation. Use LS: A7-7B, A7-7C and A7-7D to strengthen student understanding of concepts. Use text material to strengthen student understanding of concepts. Chapter 5 in Combine Harvesting and Combines-Reducing Harvesting Losses (VAS 3049) are recommended.

Objective 3: Identify proper maintenance procedures for grain harvesting equipment.

Anticipated Problem: What maintenance procedures should be followed for grain harvesting equipment?

- III. Proper maintenance and service adjustments are necessary to assure efficient, safe operation of the combine. Costly repairs, premature wear, loss of field time, and accidents can be reduced if the combine is properly maintained and adjusted.
 - A. The operator's manual for the machine should be used in reference to specific maintenance intervals, location of service points, and instructions for the performance of maintenance and service adjustments.
 - B. The following are general maintenance practices that a good machine operator should always follow in order to make operating and maintaining the combine much easier and safer.
 - 1. Before starting the harvest season, preliminary inspections and adjustments should be made following the guidelines in the operators/owners manual.
 - 2. Always keep the machine clean. Before starting the combine, clean all field trash, mud, and excess grease and oil from the machine.

3. Make sure that nuts, cap screws, shields, and sheet metal parts are tight. A loose shield can vibrate, produce excess heat, produce irritating noise, and cause a machine to fail if it falls in the way of moving parts.
4. Inspect the combine every day before starting. A brief look at all areas of the combine can help you spot potential machine failures and safety hazards.
5. Keep maintenance records. A simple chart showing when lubrication and service adjustments were made can help insure that all needed maintenance has been performed.
6. Do not abuse the machine. Proper lubrication and adjustment is of little help if the operator abuses the machine.
7. Check all fluid levels daily prior to starting.
8. Lubricate bearings and chains as called for in the operator's/service manual.
9. Check tire air pressures periodically throughout the harvesting season.
10. Check belts frequently for correct tension, excessive wear, tearing, cracking, swelling, and unraveling.
 - a. When replacing a belt never pry it over the rim of a sheave.
 - b. Wipe off oil and grease as soon as they are spilled and then clean the belt with suitable cleaner that will not soak into it.
 - c. Clean belts periodically in mild soap and water, do not use strong detergents.
 - d. Use of belt dressings is not recommended because they may deteriorate the belt.
 - e. Check pulleys for misalignment, excessive wear, damage, distortion, and accumulation of dirt and debris in the bottom of grooves.
11. Maintain correct chain tension, $\frac{1}{4}$ inch of sag per foot, between shaft centers.
 - a. Chains should be removed from the combine for cleaning and lubrication at the end of every season.
 - b. Add or remove offset links (half links) to ensure correct length and tension.
 - c. Do not add new links to an old chain or old links to a new chain, this will change the bite of the chain as it enters and leaves the sprocket.
 - d. Check alignment of all sprockets in drive and correct misalignment when necessary.
 - e. Do not put a new chain on worn sprockets, as its life will be shortened.

Use TM: A7–7H provide examples of the servicing of combine belts and chains. An alternative approach is to transfer the information from the transparency masters to a multimedia presentation. Use text material to strengthen student understanding of concepts. Chapter 5 and 6 in Combine Harvesting and Combines Selecting and Servicing (VAS 3048) are recommended.

Objective 4: Explain the principles of operating grain drying and handling equipment.

Anticipated Problem: What are the principles for operating grain drying and handling equipment?

IV. The principles involved in the operation of grain drying and handling equipment involve factors relating to system design and the removal of moisture

A. Goals of a well designed drying system include:

1. Timely harvest of top quality grain.
2. Safe and pleasant working conditions.
3. Ability to do important drying jobs efficiently such as:
 - a. Holding wet grain to be dried.
 - b. Drying wet grain
 - c. Cooling dried grain.
4. Capacity to handle grain at the harvesting rate.
5. Provisions for easy expansion in the future due to increased volume and harvesting rate.

B. Grain dries due to the removal of water, leaving dry matter.

1. Grain is harvested at high moisture contents to minimize field losses.
2. Grain that is harvested as too wet for safe storage is usually dried for maximum marketing potential and storage flexibility. Grain must be artificially dried to reduce the moisture content to a safe storage level to prevent spoilage.
 - a. A fan picks up air, carries it over an energy source (gas, electric, solar, etc.) to improve its moisture-holding capability, pushes the air through the grain mass to absorb the moisture from the grain and then carries it outside the system.
 - b. The layer being dried is referred to as the **drying zone**—only the grain in this zone is drying. The grain above this zone remains wet while the layer below is dry.
 - c. The leading edge of the drying zone is called the **drying front**.
4. **Equilibrium moisture content** is the point when continued contact with the drying air results in no further moisture reduction. Drying system capacity should be sufficient to receive and handle the daily harvest rate and allow for increasing capacity in the future.
5. Length of time grain can be stored at a given moisture content and temperature is known as **allowable storage time** (AST).
 - a. Drying and storage systems are designed around the allowable storage time.
 - b. A combination of high moisture content and high temperature leads to fast mold growth and rapid spoilage.
 - c. Factors that affect the condition of stored grain are insects, rodents, and bacteria.

Use TM: A7–7I to illustrate the principles of grain drying. TM: A7–7J and TM: A7–7K will be helpful in reinforcing the concepts of storage life and moisture content in grains. An alternative approach is to transfer the information from the transparency masters to a multimedia presentation. Use text material to strengthen student understanding of concepts. Grain Drying, Handling and Storage Handbook (MWPS–13) and FS Grain Drying Guide are recommended.

Objective 5: Explain the calibration of grain drying and handling equipment.

Anticipated Problem: How is grain drying and handling equipment calibrated?

- V. Calibration of grain drying equipment is important to attain the proper moisture content for stored grain. There are several factors that are taken into consideration when calibrating grain drying equipment. They include:
- A. Initial moisture content of the grain.
 - B. Temperature of the grain.
 - C. Relative humidity of the outside air.
 - D. Desired final moisture content of the grain, which is affected by the use of the grain.

Again, TM: A7–7J and A7–7K will help students in understanding this objective. An alternative approach is to transfer the information from the transparency masters to a multimedia presentation. Use text material to strengthen student understanding of concepts. Grain Drying, Handling and Storage Handbook (MWPS–13) and FS Grain Drying Guide are recommended.

Objective 6: Identify proper maintenance procedures for grain drying and handling equipment.

Anticipated Problem: What maintenance procedures should be followed for grain drying and handling equipment?

- VI. Proper maintenance and service adjustments are necessary to assure efficient, safe operation of the drying and handling equipment.
- A. Costly repairs, premature wear, loss of harvesting time and accidents can be reduced if the drying and handling systems are properly maintained and adjusted. The operator's manual for the equipment should be used in reference to specific maintenance intervals, location of service points, and instructions for the performance of maintenance and service adjustments.
 - B. There are general maintenance practices to follow in order to make operating and maintaining the drying and handling systems much easier and safer.
 - 1. Thoroughly clean all grain drying and handling equipment prior to use. Always keep machinery and equipment clean. Excessive build-up of trash, debris, and fine dirt can cause heat build-up, part fatigue and failure, and/or fires.
 - 2. Inspect all bearing and friction surfaces for excessive wear.
 - 3. Make sure that shields and other safety equipment are in place at all times.

4. Keep up-to-date maintenance records. A simple chart showing when lubrication and service adjustments were performed can help to insure that all needed maintenance has been performed.
5. Inspect the equipment every day. A brief inspection of all areas can help you spot potential machine failures and safety hazards.
6. Check all fluid levels daily.
7. Lubricate bearings and chains as called for in the operator's/service manual.
8. Check belts frequently for correct tension, excessive wear, tearing, cracking, swelling, and unraveling.
9. Maintain correct chain tension, $\frac{1}{4}$ inch of sag per foot, between shaft centers.
10. Check all electrical equipment prior to use.
11. Insure that all fire extinguishers are properly charged and in working order.

Use text material to strengthen student understanding of concepts. Grain Drying, Handling and Storage Handbook (MWPS-13) and FS Grain Drying Guide are recommended. Reinforce the major concepts of this objective through classroom discussion.

Objective 7: Identify the grain quality standards associated with a given crop.

Anticipated Problem: What are the grain quality standards?

- VII. A set of standards established by the United States Department of Agriculture (USDA), known as the Grain Grading Standards (USDA 1995), serve as a general guideline for characterizing physical grain quality.
- A. This system was developed in 1916 to enable grain merchants to trade grain using consistent, measurable quality criteria.
 - B. Since 1916, numerous changes in the grading standards have occurred to reflect changes in technology (the ability to measure quality) and customer demands.
 - C. Grade quality measurements are categorized as non-grade determining factors, grade determining factors, and special grades.
 1. Non-grade determining factors include moisture and possibly dockage, depending on the grain.
 2. Grade determining factors include test weight, damaged kernels, foreign material, broken kernels, odor, and heating. Grades are assigned based on the lowest factor. Sample grade is the lowest possible category in the grading system.
 3. Special grades, depending on the grain, include infested, ergoty, garlicky, and smutty. These words are added to the grade designation but do not determine the numerical grade.

Use text material to strengthen student understanding of concepts. The Official United States Standards for Grain are recommended. Have students research the Standards on the Internet. Assign different crop standards to various groups of students. Refer the class to: www.access.gpo.gov/nara/cfr/waisidx_01/7cfr810_01.html. This

is the Government Printing Office Web site. It contains the Code of Federal Regulations and includes the Official Grain Standards.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle.

Application. Use the accompanying lab sheets to help students in applying the lesson's content.

LS: A7-7A—Combine Data Sheet

LS: A7-7B—Calculating Harvest Loss—Corn

LS: A7-7C—Calculating Harvest Loss—Soybeans

LS: A7-7D—Calculating Harvest Loss—Small Grain

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance, on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1 = c, 2 = i, 3 = a, 4 = b, 5 = e, 6 = f, 7 = h, 8 = j, 9 = g, 10 = d

Part Two: Completion

1. handling
2. non-grade, grade, special
3. $\frac{1}{4}$
4. quality
5. field losses
6. repairs, wear, time, accidents
7. harvesting, threshing
8. allowable storage time
9. insects, rodents, bacteria

Part Three: Short Answer

1. Timely harvest of top quality grain, safer and pleasant working conditions, ability to do important drying jobs efficiently, capacity to handle grain at the harvesting rate, provisions for easy expansion to future, due to increased volume and harvesting rate.
2. Cutting, feeding, threshing, separating, cleaning, handling.

Test

Lesson A7-7: Operating, Calibrating, and Maintaining Grain Harvesting and Handling Systems

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|-----------------|----------------|---------------------------------|
| a. tailings | e. drying zone | i. allowable storage time |
| b. cleaning | f. threshing | j. equilibrium moisture content |
| c. cutting | g. feeding | |
| d. drying front | h. lodging | |

- _____ 1. Cutting or gathering the crop.
- _____ 2. Length of time grain can be stored at a given moisture content and temperature.
- _____ 3. Material that is not completely threshed or separated.
- _____ 4. Removing the grain from the trash.
- _____ 5. Layer of grain being dried.
- _____ 6. Removal of the grain from the head, seedpod or cob.
- _____ 7. Inability of the crop to stand.
- _____ 8. Point when continued contact with the drying air results in no further moisture reduction.
- _____ 9. Delivering the crop material to the threshing unit in a steady, uniform flow.
- _____ 10. Leading edge of the drying zone.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

- 1. Moving the grain throughout the combine is referred to as the _____ function.
- 2. Grade quality measurements are categorized as _____, _____ and _____ grades.
- 3. A chain in correct tension would have _____ inch of sag per foot, between shaft centers.

4. The Grain Grading Standards were developed in 1916 to enable grain merchants to trade grain using consistent, measurable _____ criteria.
5. Grain is harvested at high moisture contents to minimize _____.
6. If the drying and handling system is properly maintained and adjusted costly _____, premature _____, loss of harvesting _____ and _____, can be reduced.
7. The name combine developed when the _____ and _____ operations were combined into one complete machine.
8. Drying and storage systems are designed around the _____.
9. Factors that affect the condition of stored grain are _____, _____ and _____.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. What are the five goals of a well designed drying system?

2. What are the six basic functions that a combine performs?

TM: A7-7A

COMBINE WITH CORN HEAD



(Courtesy, John Deere)

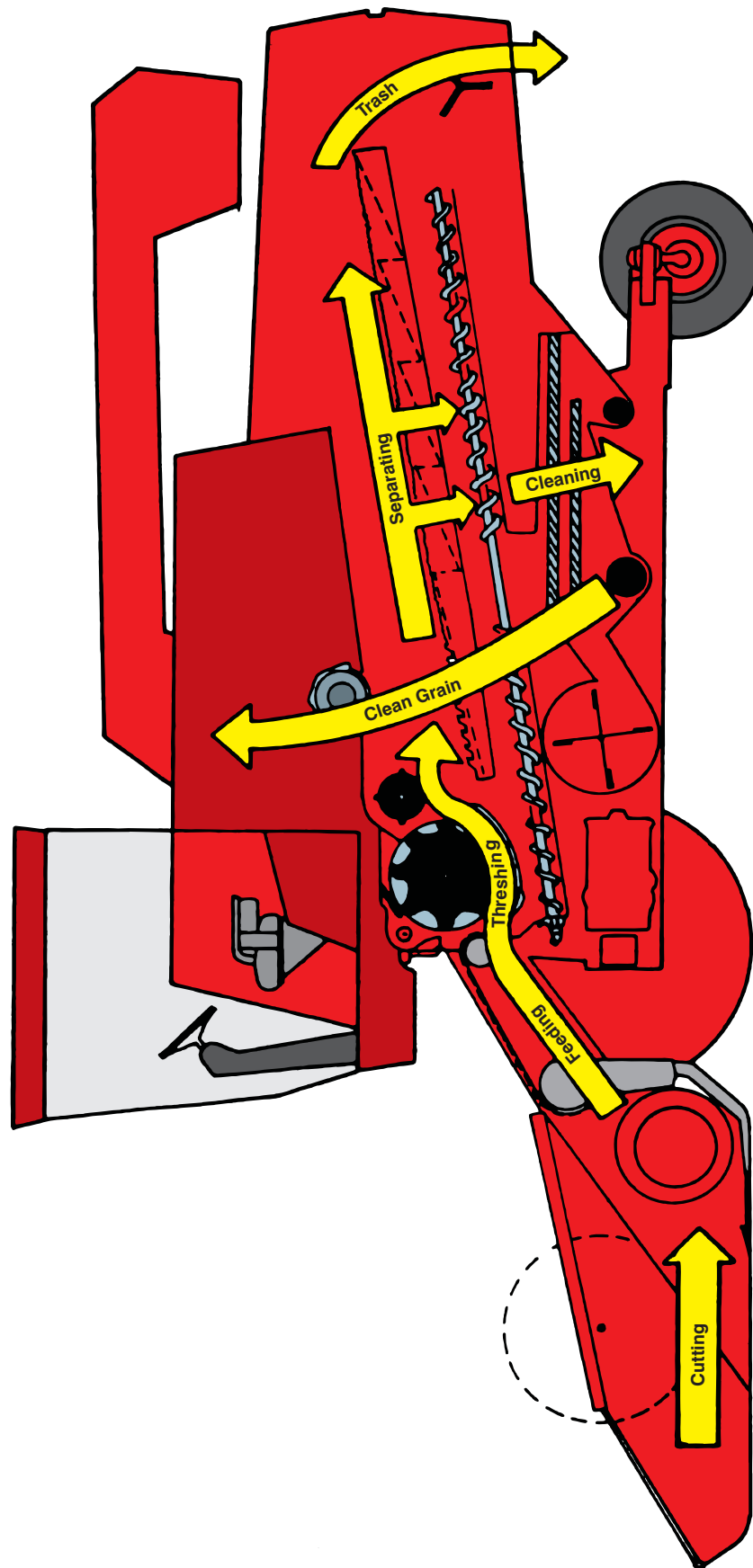
TM: A7-7B

COMBINE WITH SOYBEAN HEAD

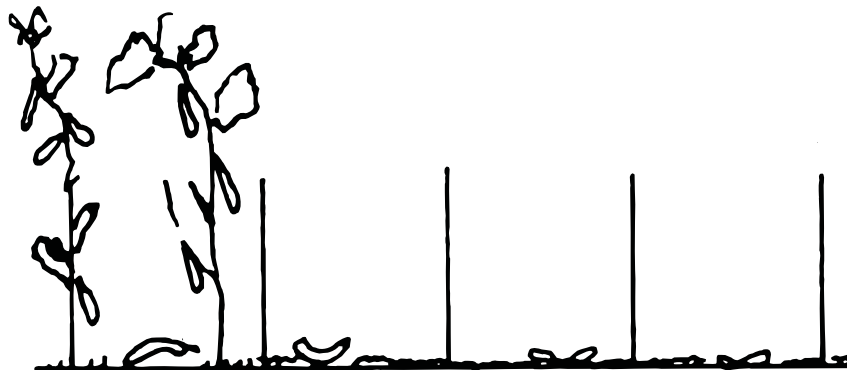


(Courtesy, John Deere)

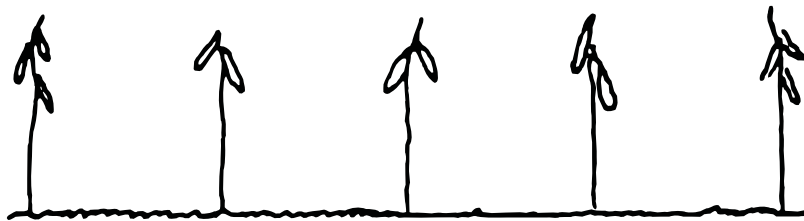
HOW GRAIN FLOWS THROUGH A COMBINE



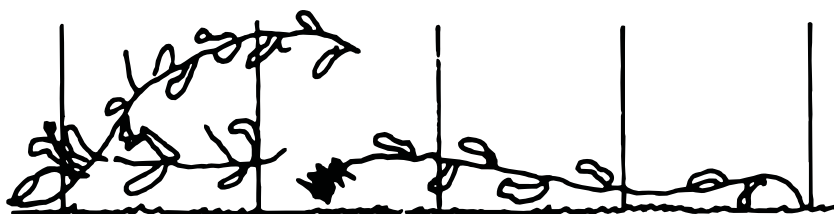
TYPES OF HEADER LOSS— SOYBEANS



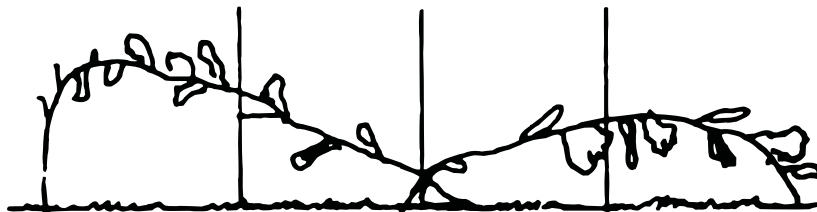
Shatter



Stubble

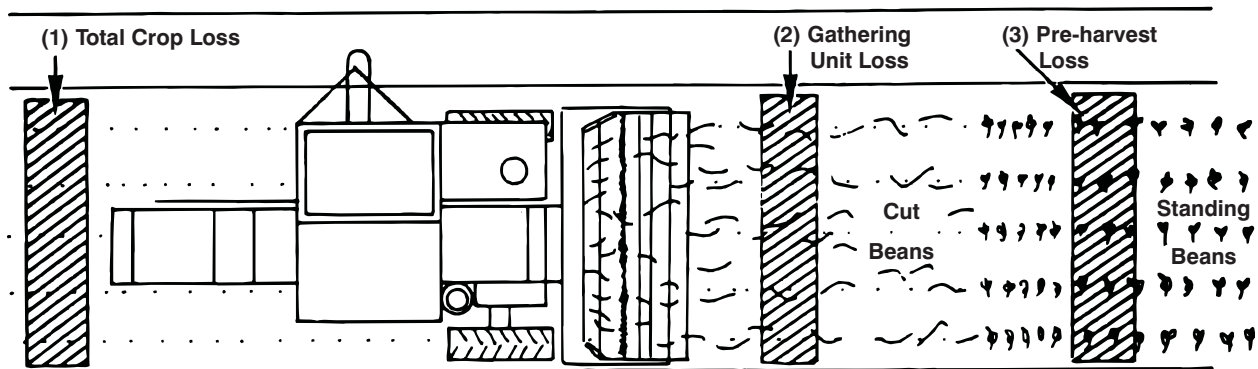


Stalk



Lodged

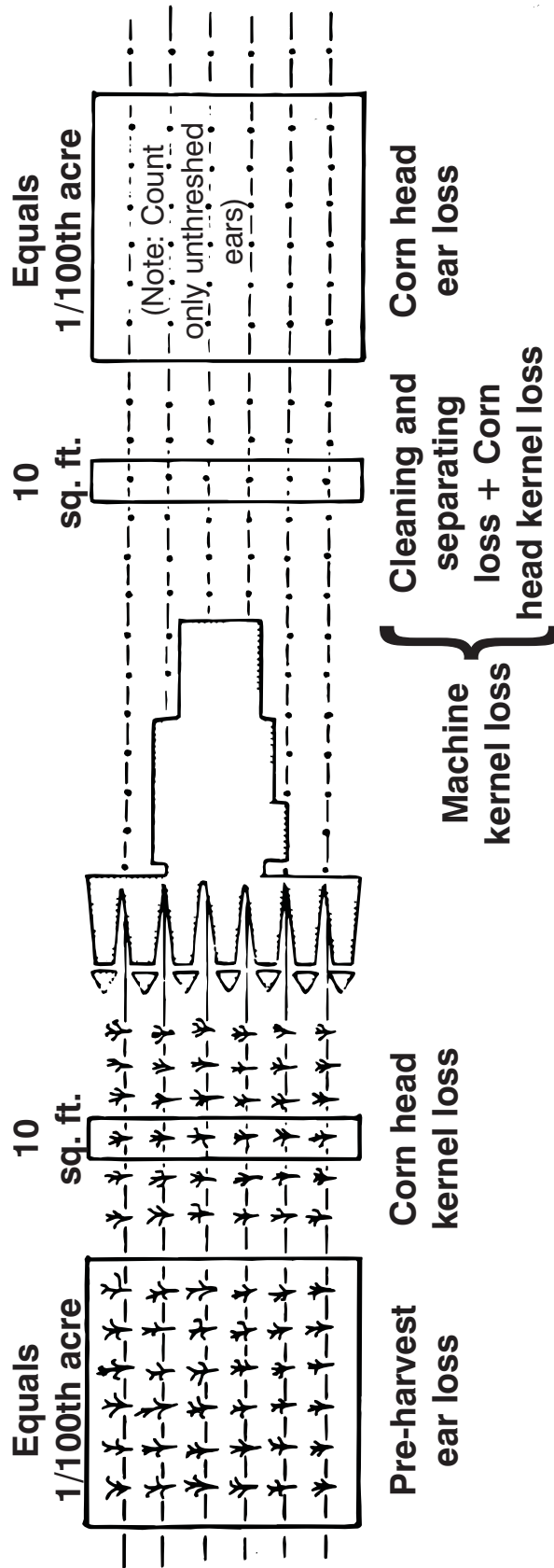
CALCULATING SOYBEAN LOSS



LOSS DATA WORKSHEET				
Source of Loss	Column A Beans Found in 10 sq. ft. area	Number of Beans = to 1 bu./acre	Column B Your Bean Loss in bu./acre	Column C Acceptable Loss Level in 40 bu./acre yield
1. Total Crop Loss		40		1.3
2. Pre-Harvest Loss		40		0.1
3. Machine Loss		40		1.2
4. Gathering Unit Loss		40		1.1
Totals of:		40		0.4
a. Shatter				
b. Loose Stalk		40		0.2
c. Lodged Stalk		40		0.2
d. Stubble		40		0.3
5. Cylinder and Separation Loss				0.1

MEASURING CORN LOSSES

TM: A7-7F



Machine kernel loss – Corn head kernel loss = Cleaning and separating loss

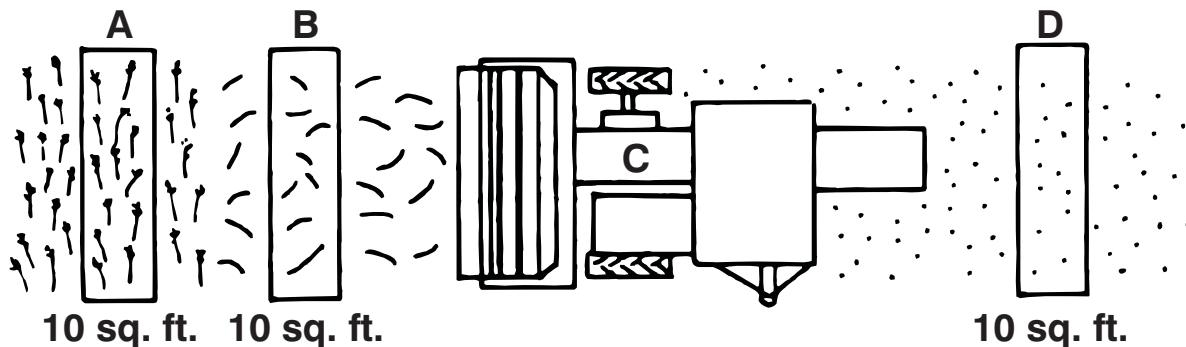
Cylinder loss = Kernels on partially shelled cobs

Machine kernel loss – Corn head loss = Total machine loss

DETERMINING SMALL GRAIN LOSSES

Source of Loss	Kernels of grain/ 1 sq. ft.	No. of grains/ sq. ft. to = 1 bu/A*	Loss bu./A	Acceptable loss/acre
1. Grain loss (behind combine) (Area D)	_____ ÷ _____	= _____	_____	_____
2. Pre-harvest loss (Area A)	_____ ÷ _____	= _____	_____	_____
3. Total machine loss		= _____	_____	_____
4. Header and pre-harvest loss (Area B)	_____			
5. Header loss (B-A)	_____ ÷ _____	= _____	_____	_____
6. Cylinder and separation loss		= _____	_____	_____

*Wheat—20 grains; Barley—15 grains; Oats—12 grains; Rye—24 grains.



WHEAT HARVEST

A = 275 loose grains or loose heads.

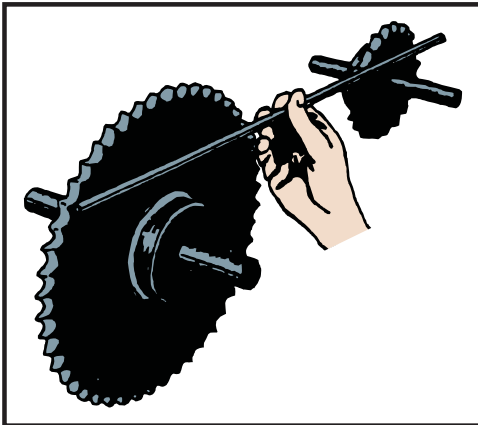
B = 400 loose grains or loose heads.

C = 224 loose grains or loose heads.

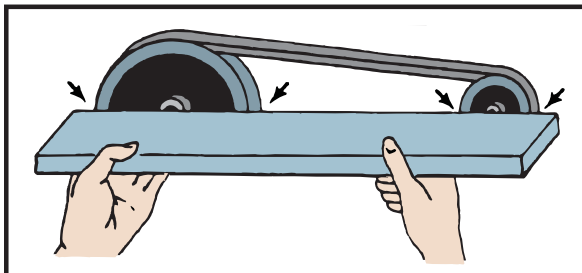
D = 625 loose grains or loose heads.

Note: These counts must be divided by 10 to get 1 sq. ft. for first column.

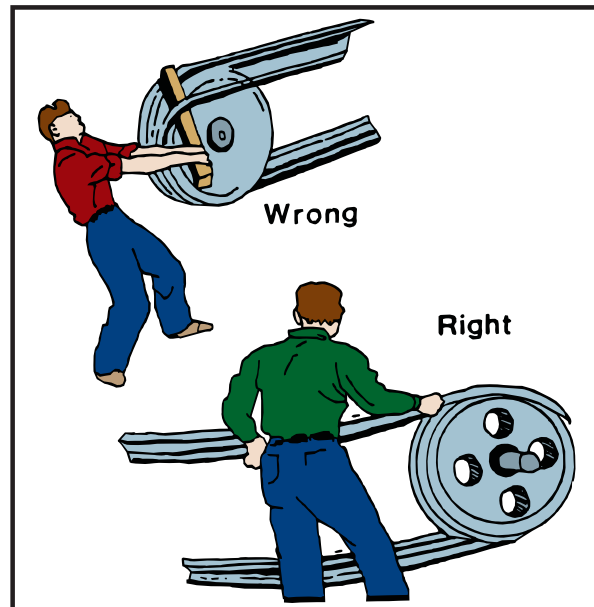
COMBINE SERVICING— BELTS, CHAINS



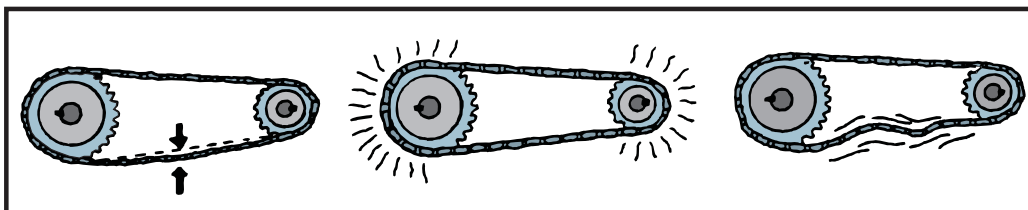
Check sprocket alignment with a straight edge or string. Misalignment will cause rapid wear of sprockets and chains.



Check pulley alignment. Pulley misalignment will result in distortion of belts which results in excessive wear and damage.

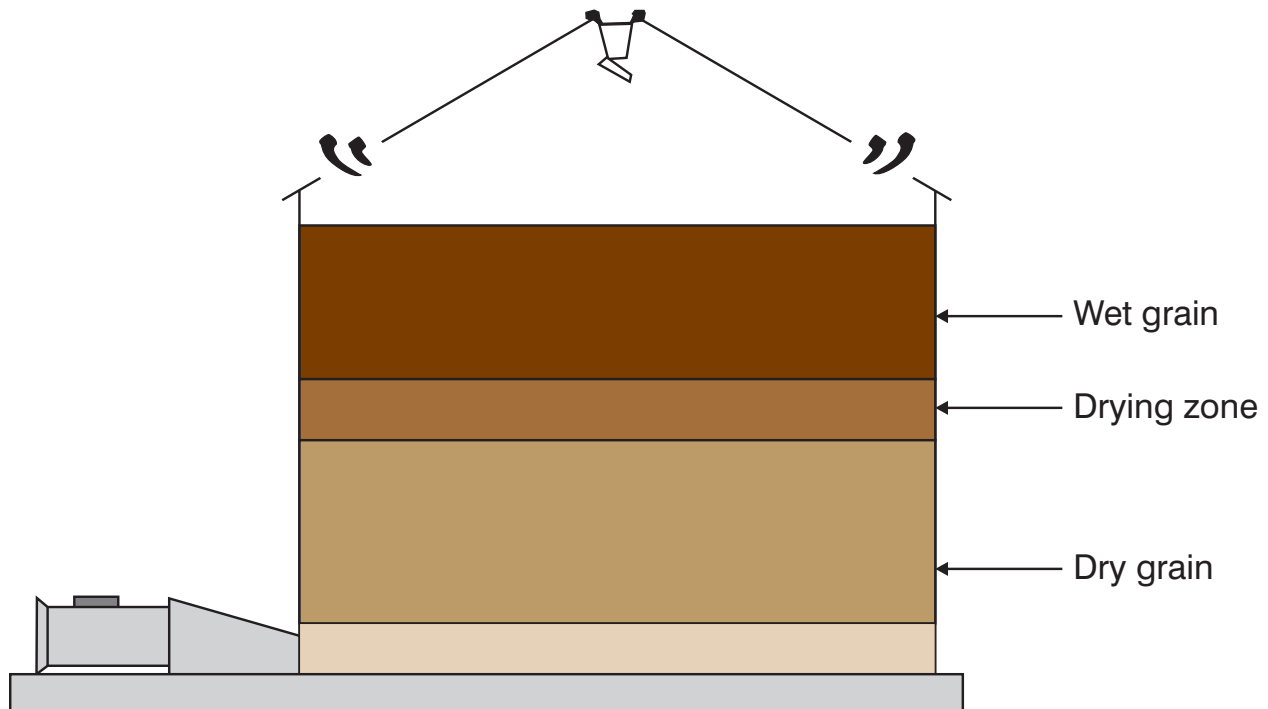


Never pry a belt over a pulley. This breaks the cords in the belt and will result in belt roll-over and early belt failure.



Keep chains adjusted to $\frac{1}{4}$ " sag per foot between shaft centers.
Over tightening produces rapid chain and sprocket wear.
Loose chains "whip" and can cause chain and sprocket damage.

GRAIN DRYING PRINCIPLES



The drying zone starts at the bottom. When it reaches the top, drying is completed. Spoilage will occur if the drying zone doesn't reach the top within the allowable storage time.

MAXIMUM STORAGE LIFE FOR SHELLLED CORN

Grain Temperature (°F)	Moisture Content (% wet basis)							
	15½	18	20	22	24	26	28	30
30	2,276	648	321	190	127	94	74	61
35	1,517	432	214	126	85	62	49	40
40	1,012	288	142	84	56	41	32	27
45	674	192	95	56	37	27	21	18
50	450	128	63	37	25	18	14	12
55	299	85	42	25	16	12	9	8
60	197	56	28	17	11	8	7	5
65	148	42	21	13	8	6	5	4
70	109	31	16	9	6	5	4	3
75	81	23	12	7	5	4	3	2
80	60	17	9	5	4	3	2	2

STORAGE MOISTURE CONTENTS

Grain Drying Tables								
	Equilibrium Moisture Contents							
Relative Humidity %	20	30	40	50	60	70	80	90
Corn %	7	8	10	11	13	14	16	18

Maximum Moisture Contents for Grain Harvest and Safe Storage		
Grain Type and Storage Time	Maximum Moisture Content	
	For Harvesting (%)	For Safe Storage (%)
Shelled corn and sorghum		
Sold as # grain by spring	30	15
Stored 6–12 months	30	14
Stored more than 1 year	30	13
Soybeans		
Sold by spring	18	14
Stored up to 1 year	18	12
Stored more than 1 year	18	11
Wheat, oats, barley		
Stored up to 6 months	20	14
Stored more than 6 months	20	13
Sunflower		
Stored up to 6 months	22	10
Stored more than 6 months	22	8
Flaxseed		
Stored up to 6 months	15	9
Stored more than 6 months	15	7
Edible beans		
Stored up to 6 months	20	16
Stored more than 6 months	20	14

Lab Sheet

Combine Data Sheet

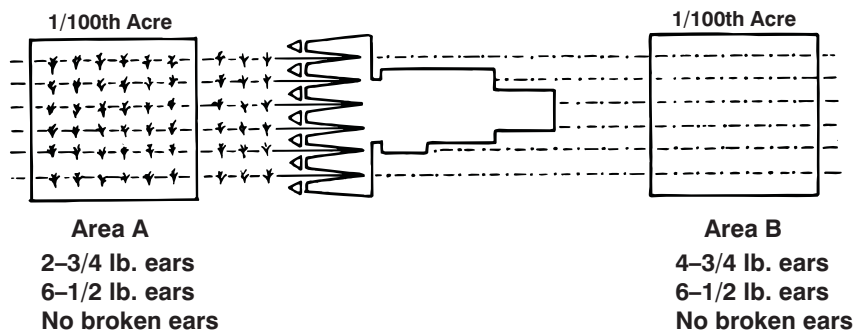
Directions: Complete this data sheet for a combine in your area.

1. Make _____ Model _____
2. Type of head _____ Width _____
3. Does this combine have a floating cutter bar? _____
How can you tell if a head has a floating cutter bar? _____
4. How is the reel or corn snap roller turned? _____

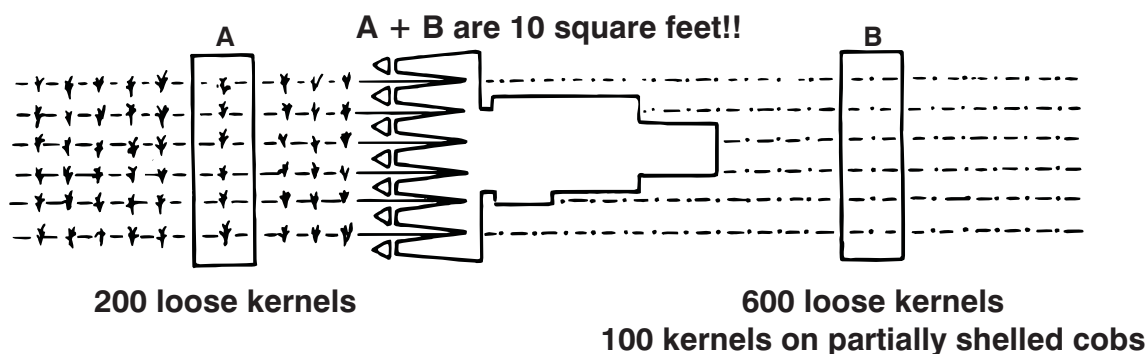
5. Is the reel a slat type or pickup type? _____
6. Is the reel fore and aft adjustment mechanical or remote controlled? _____
7. How many row cornhead is used or can be used on this combine? _____
8. How many feeder chain sections are across the feeder throat? _____
9. Cylinder type? _____ Type of beater? _____
10. How many sections of straw walkers? _____
11. How many holes across one section of straw walker? _____
12. Does the machine have an (auger) or (return pan) at the end of the straw walker?
13. Where is the clean grain fan located on the combine? (You are in the driver's seat).
14. How many augers in the grain tank? _____
15. What drives the cylinder? _____
16. Where are the concaves adjusted? _____
17. Size of the front tires? _____ rear tires? _____
18. Does this combine have a straw spreader? _____
19. Why is leasing a combine more of an advantage to some people than buying?
20. How many steps are on the entrance ladder? _____

Lab Sheet

Calculating Harvest Loss—Corn



Harvesting Losses		
1. Total Ear Loss (behind machine)	_____	Bu./Acre
2. Pre-harvest loss	_____	Bu./Acre
3. Corn head loss	_____	Bu./Acre



Determining Total Kernel Loss				
Record Kernel Losses	No. of Kernels/Sq. Ft. Counted		No. of Kernels/Sq. Ft. = 1 Bu./A	Loss Bu./A
1. Loose kernel loss behind combine	_____	÷	2	= _____
2. Loose kernel loss (Snapping rolls)	_____	÷	2	= _____
3. Separator and shoe loss (No. 1 minus No. 2)	_____	÷	2	= _____
4. Cylinder loss (Kernels on partially shelled cobs)	_____	÷	2	= _____
5. Total loss/acre (Add lines 2, 3, and 4)				= _____
6. Total ear loss/acre (Line 3, Harvesting Losses)				= _____
7. Total corn harvesting loss (Line 5 + Line 6)				= _____

Lab Sheet

Calculating Harvest Loss—Soybeans

COMBINES—REDUCING HARVESTING LOSSES

Figure the *soybean loss* using the data on the attached page.

Sources of Loss	Column A Beans Found in 1 Sq. Ft. Area	Number of Beans to = 1 Bu./Acre	Bean Loss in Bu./Acre	Total
1. Total Crop Loss	_____	÷ 4	_____	
2. Pre-Harvest Loss	_____	÷ 4	_____	
3. Machine Loss (Line 1 minus Line 2)				_____
4. Gathering Unit Loss Total of: (From Area B)				
a. Shatter (Loose beans—pre- harvest pod)	_____	÷ 4	_____	
b. Loose pod (Loose pod—pre- harvest pod)	_____	÷ 4	_____	
c. Loose stalk (Not attached to plant)	_____	÷ 4	_____	
d. Lodged stalk (Not attached to plant)	_____	÷ 4	_____	
e. Stubble (Pods attached to stubble)	_____	÷ 4	_____	
f. Total gathering unit loss (To- tal line a through line e)				_____
5. Cylinder and Separation Loss Machine loss (line 3) minus Header loss (line 4f)				_____

A = 62 beans

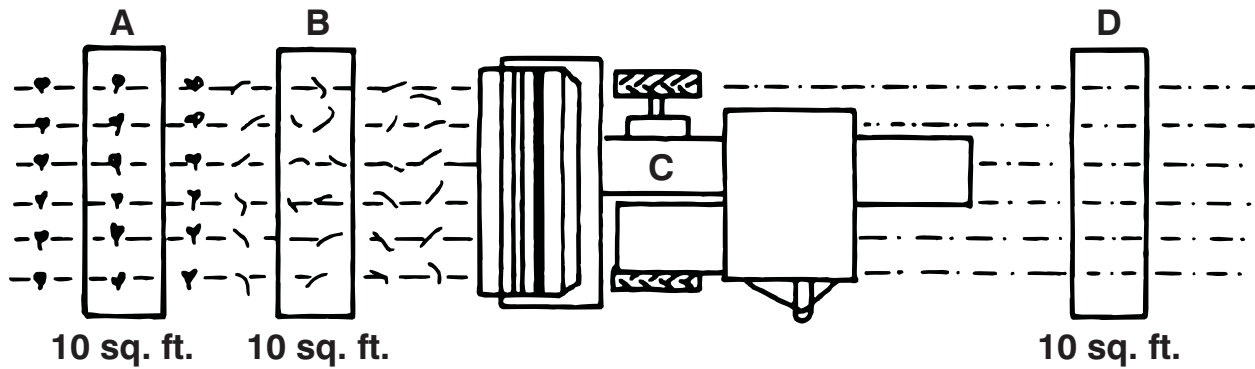
B = Loose stalk—29 beans, Shatter—142 beans, Stubble—22 pods \times 3 beans/per pod = 66 beans, Lodged stalk—0, Pods—0.

C = 194.8 beans

D = 432 beans

The soybean yield for this field is 45 bu. per acre. How efficient is this combine?

65.5% 75% 79.4% 83.2%



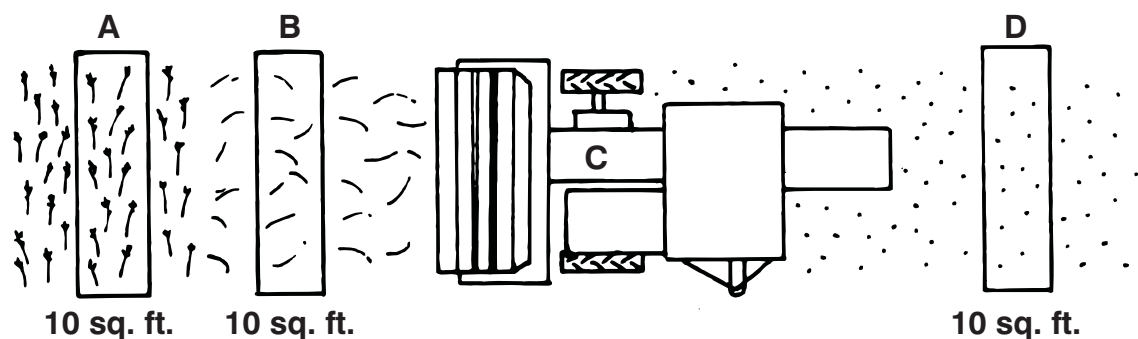
Note: These counts must be divided by 10 to get 1 sq. ft. for Column A

Lab Sheet

Calculating Harvest Loss—Small Grain

Source of Loss	Kernels of Grain/ 1 Sq. Ft.	No. of Grains/Sq. Ft. to = 1 Bu./A*	Loss Bu./A	Acceptable Loss/Acre
1. Grain loss (behind combine) (Area D)	_____	÷ _____	= _____	_____
2. Pre-harvest loss (Area A)	_____	÷ _____	= _____	_____
3. Total machine loss			= _____	_____
4. Header and pre-harvest loss (Area B)	_____			
5. Header loss (B-A)	_____	÷ _____	= _____	_____
6. Cylinder and separation loss			= _____	_____

*Wheat—20 grains; Barley—15 grains; Oats—12 grains; Rye—24 grains.



WHEAT HARVEST

A = 200 loose grains or loose heads.

B = 300 loose grains or loose heads.

C = 100 loose grains or loose heads.

D = 400 loose grains or loose heads.

Note: These counts must be divided by 10 to get 1 sq. ft. for first column.